ABSTRACT

Transportation has become an integral part of the economy and a vital as a daily activities which means it is also an essential things towards source of greenhouse gas emissions. This research seek to investigate about level of gas emissions by heavy-duty trucks at Cross Border Checkpoints, Bukit Kayu Hitam, Kedah Darul Aman, Malaysia. Basically, the gas emissions that produces by heavy-duty trucks is increasing until contribute into environmental and physical impacts. For this purpose, the study objective is to calculate the level of gas emissions rate by interpreting in three types of chemical component. It includes of carbon dioxide (CO$_2$), methane (CH$_4$) and nitrous oxide (N$_2$O). In the present work, the calculation and estimation of chemical component defined by grams per mile (g/mi). The data collected from Cross Border Checkpoints, Bukit Kayu Hitam, Kedah, Malaysia that will be obtained to shows in the result. In that part, a strategies and recommendations has been made to solve the gas emissions by heavy-duty trucks problems from being erupted. This paper can be used as a platform for future research in area of sustainability in green transportation.

Keywords: level of gas emissions, chemical component, physical impacts, environmental, sustainability, green transportation

BACKGROUND OF STUDY

Cross Border Checkpoints, Bukit Kayu Hitam is stated in Kedah’s which is as a main border of Malaysia and Thailand. It also has been marked at the end of the north-south expressway and Malaysia Federal Route 1. Trade relationships between Malaysia and Thailand is very well (Efficient Cross-Border Transport Models, 2012). Besides that, this situation will serve as contributing factor and enhance the Level of Service (LOS) at cross border businesses (Lakshmanan & William, 2001). The export and import goods in Thailand to Malaysia includes of computers ($19 billion), delivery trucks ($10.7 billion), integrated circuits ($9.4 billion), refined petroleum ($8.43 billion) and cars ($6.92 billion) based on Observatory of Economic Complexity. Malaysia export goods consists of electronic parts, rubber products, food products and furniture (Efficient Cross-Border Transport Models, 2012).

The common type of vehicles that used in Bukit Kayu Hitam border was heavy-duty trucks. About 80 percent of the cargo are fully containerized. Operations of transportation mainly conducted by large multinationals between the subsidiary
companies in Malaysia and Thailand. Mostly, trans-loading of cargo take a distances about 2 kilometres of the border in Bukit Kayu Hitam, Malaysia after clearing the goods by customs. Privatized warehouse owned by certain companies which are close to the border for a container swap takes place easily (Efficient Cross-Border Transport Models, 2012).

The environmental impacts will lead into greenhouse gas emissions, global warming, air pollution and others. Congestion, accident, delay, noise, air pollution and damage infrastructure are part of the negative effects to road transport (Tyrinopoulos, Y., & Antoniou, C, 2013). Therefore, this paper shed lights on the chemical component that contains in gas emissions at Cross Border Checkpoints, Bukit Kayu Hitam. This research also goes one step forward in placing particular emphasis on level of gas emissions rate for heavy-duty trucks.

**PROBLEM STATEMENT**

Amount of greenhouse gas emissions in Cross Border Checkpoints, Bukit Kayu Hitam that emits is dependent on the vehicle type which is heavy-duty trucks diesel engine. The heavy-duty trucks energy use was increasing slowly year by year and lead into various chemical component such as carbon dioxide (CO$_2$), methane (CH$_4$), nitrous oxide (N$_2$O) (Average In-Use Emissions from Heavy Duty Trucks, 2008). Greenhouse gas emissions and air pollution is the major challenges in transportation that becomes main scapegoat because of the strongest contribution towards greenhouse gas emissions in environment (Weifeng Li, 2016).

Besides that, transportation being process from the burning fuel for car, trucks, ships, trains and planes. Over 90 percent of the fuel used for transportation based on gasoline and diesel (Environmental Protection Agency, 2016). About 5 percent of the vehicles on the road represented medium and heavy-duty vehicles while 20 percent of transportation emission such as heavy-duty trucks urge greater distances (Environmental and Energy Study Institute, 2015). This shown that greenhouse gas emissions by heavy-duty trucks is a huge issue happened in Cross Border Checkpoints, Bukit Kayu Hitam.

**LITERATURE REVIEW**

There are variety of a view logistics presented such as, Philip Kotler explains logistics it’s an activity that involves planning, executing and controlling the flow of goods from origin to final destination destinations to fulfill customer demand needs. In other side, logistics is defined as a process that involves a strategic management and procurement, movement and storage methods, replacement parts and inventory and related information flows managed by a company in their own way to their advantage based on cost effective application. (Christopher, 2011). In logistics, transportation is an important element and is needed in the whole production procedure from manufacturing until arrived to customer and returns (Tseng, Yue & Taylor, 2005). Transport movement of goods and people from point of origin to their intended destination. In addition, the raw material used to enable brought to the place of production to be used
to produce a product. Besides that, an essential part of life in a place and in the place livable (Hussein, 2013).

In this century, pollution is something very worrisome and difficult to contain. Pollution is a process whereby environmental causes such as land, water, air or other parts of the environment affected by being dirty and unsafe or unsuitable for use. This can occur when there are any materials that have been contaminated inserted in the natural environment. According Hassam (2016), an act that interferes the ecosystem by the action using or introducing the harmful substances that affect the environment and contaminate consequently impact on the living in the ecosystem. Pollution is one of the biggest threats that are not noticed by humans because it is of their own doing that harm the environment (Sim, 2014).

Emissions from heavy duty trucks not only affects the quality of the air only but also affects the global climate change and main source it is carbon dioxide (CO₂). Among the major contributors to greenhouse gas emissions is the transport sector with a rate of 36% in 2010 its heavy duty truck. Eggleston, & Walsh (1998), stated that road transport is a major source of carbon dioxide (CO₂) and other substances such as mono-nitrogen oxides (NOx), cobalt (Co), non-methylene volatile organic compounds (NMVOCs) also nitrous oxide (N₂O), methane (CH₄) and ammonia (NH₃) are in smaller quantities percentage. Other authors stated that there are main gases for greenhouse gas emissions which is carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O) (US Department of Transportation, 2010).

**DESCRIPTIVE FLOWCHART**

Understand the current and future greenhouse gas emissions by heavy-duty trucks.

Determine and collect raw data.

Identify the types of fuel engine and chemical component.

Calculate change in greenhouse gas emissions from baseline.

Emerge and prioritize future actions.

Figure 1
Descriptive flowchart

**DATA ANALYSIS & DISCUSSION FINDINGS**

According to Shamoo and Resnik (2003), several analytic procedures in term of “provide a method in drawing inductive inferences from data and differentiate the signal (the phenomenon of interest) from the noise (statistical fluctuations) available in the data”. First step of findings started with the interview session at the cross border,
Bukit Kayu Hitam. The interview sessions was focusing towards participation on the focus group of the organization which is customs organizations at Cross Border Checkpoints, Bukit Kayu Hitam. On these organizations, have interviewed two representatives on Customs Department (Puan Nursuliha Sujak and Puan Siti Zuraidah), Warehouse Department (Encik Subari Dahlan) and Health Department (Encik Ahmad Nazmi).

The next second findings, the researchers calculate on the level of gas emissions for the statistical result on this study. *Table 1* below shows the prediction heavy-duty trucks emissions for year 2021 using time series calculation models:-

<table>
<thead>
<tr>
<th>No</th>
<th>Emission Factor</th>
<th>Weighted Moving Average</th>
<th>Moving Average</th>
<th>Exponential Smoothing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CO₂ kg/mile</td>
<td>41225.1</td>
<td>39958.0</td>
<td>42589.2</td>
</tr>
<tr>
<td>2</td>
<td>NH₄ g/mile</td>
<td>423.5</td>
<td>373.2</td>
<td>387.0</td>
</tr>
<tr>
<td>3</td>
<td>N₂O g/mile</td>
<td>395.3</td>
<td>383.2</td>
<td>408.4</td>
</tr>
</tbody>
</table>

Every amount for each time series calculation models shown different value and from that’s can be seen which one more accurate from Figure 2 below:-

*Figure 2*

Prediction heavy-duty trucks emissions for year 2021 by using time series calculation models

From this research it can be concludes that among these three emissions factor CO₂ contributed more than CH₄ and N₂O in heavy-duty trucks emissions. Amount of CO₂ increasing rapidly (Bierwirth, 2014) based on finding that have been shown above and this causes more greenhouse gas emissions (Rohrer, 2007). From prediction in 2020 CO₂ will be the highest with 43820.6 kg/mile.

According Robertson (2007), when the level reach 1000 part per million (ppm), will affected all mankind at that around. 1000 ppm of CO₂ it’s equal with 1000 kg of CO₂. So this means, all rate CO₂ emissions each year from 2016 until 2021 will seriously
affect the population at Cross Border Checkpoints, Bukit Kayu Hitam, Kedah. In addition, in term of transportation, a relatively high level of CO$_2$ in the vehicle related with decreasing anchored and the exhaustion have serious implications for the safety of drivers.

CONCLUSION AND RECOMMENDATIONS

Nowadays, the air pollution has increasingly. Based on this research, from the literature it has been focused on the types of chemical component that occurs from the heavy-duty trucks and its impact on the air pollution. Therefore, the researchers need to perform a study on assuming the level of gas emissions on the heavy-duty trucks that causes the pollution. In this study, the researchers have found that with this problem, they need to have some improvement and suggestion to reduce the air pollution that cause from the heavy-duty trucks. The studies have yielded some of the interesting findings on this research. The types of chemical component that the researchers were observe are on the carbon dioxide (CO$_2$), methane (CH$_4$) and nitrous oxide (N$_2$O). Most of the heavy-duty trucks at cross-border have almost same result of the pollution. However, the total amount of the emissions become heavily increase year by year and it will give a negative impact to the environment.

The suggestions on this research are they need to be more strictly to set a standard on the in-use inspection and also maintenance of the heavy-duty trucks. At the cross-border between Malaysia and Thailand, they need to develop one department to inspect on the level gas emissions on each trucks and check on the maintenance standards of the heavy-duty trucks. Based on the research, it can see that Jabatan Alam Sekitar, Kedah, Malaysia needs to play as a main role and have a good responsibility on the inspection of level of gas emissions that specified in Cross Border Checkpoints, Bukit Kayu Hitam, Kedah to reduce the pollution quality.

Other than that, on this research also suggest that the authorities need to check on the pollution with using the technology tools frequently. The authorities responsible to check on the pollution at cross border at least three times per year so that they know the problem that occurs and know that the effect not only to the environment but also will effect to the people health that lives near the cross border. Other suggestion is the utilizing of the tough enforcement of the heavy-duty trucks standard. With the tough enforcement, it is for ensuring and encouraging compliance of the air pollution regulations. These studies have been observed that the old heavy-duty trucks will produce much more level of gas emission rather than the new one. As a result, it is good if the authority takes an action to tough the enforcement of the age of the heavy-duty trucks have been used. It is one of the strategy to reduce and prevent the air pollution getting worst.

REFERENCES


